CLAIMS

1. A time-of flight range-finding sensor for range-finding by taking out a signal, which depends on a delay time of repetitive light pulses transmitted from a light source and then reflected by a target object to be measured, the time-of flight range-finding sensor comprising:

an insulator layer (3) formed on a semiconductor substrate (20);

two conductive photo-gate electrodes (1 and 2) disposed close to each other, being transparent for a wavelength of a light reflected by the target object; and

first floating diffusion layers (5 and 6) disposed under and at ends of the photo-gate electrodes,

wherein regions of the semiconductor substrate beneath the two photo-gate electrodes and beneath a gap between the two photo-gate electrodes are used as a photodetector layer (4).

2. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein each of two photo-gate electrodes has a comb-shaped geometry having a plurality of projections in a plan view, the projections of one of the photo-gate electrodes are inserted interdigitally between the projections of the other photo-gate electrode.

3. The time-of flight range-finding sensor according to either Claim 1

or Claim 2, further comprising first MOS transistors (7 and 8) configured to extract signals from the first floating diffusion layers (5 and 6), gates of the first MOS transistors are coupled to the first floating diffusion layers, respectively.

4. The time-of flight range-finding sensor according to either Claim 1 or Claim 2, further comprising second MOS transistors (9 and 10) and first signal-extraction MOS transistors (7 and 8), each of the second MOS transistors comprising:

a source (or a drain) connected to one of the first floating diffusion layer;

a second floating diffusion layer (11 or 12) serving as a drain (or a source), being connected to one of gates of the first signal-extraction MOS transistors (7 or 8); and

a gate electrode to be applied with gate voltage, being controlled so as to electrically separate the first floating diffusion layer from the second floating diffusion layer configured to allow storage of an analog signal.

5. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein the insulator layer (3) utilizes a field oxide being formed in a manufacturing procedure of a CMOS integrated circuit.

6. The time-of flight range-finding sensor according to Claim 1 or Claim 2, further comprising two diffusion layers (13 and 14) provided

under the insulator layer (3), between the photodetector layer (4) and the first floating diffusion layers (5 and 6), being doped with impurity atoms having the same polarity as the impurity atoms of the first floating diffusion layers (5 and 6).

7. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein the photo-gate electrodes (1 and 2) are made of the same material as the gate electrode of a MOS transistor in a CMOS integrated circuit, or the material being treated so as to increase optical transmissivity.

8. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein the photodetector layer (4) utilizes a low concentration p-type semiconductor substrate (20), being left as it is such that both a p-type well and an n-type well are not formed in the semiconductor substrate, in contrast with a CMOS integrated circuit in which the p-type and n-type wells are provided in the low concentration p-type semiconductor substrate (20).

9. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein the photodetector layer (4) utilizes a low concentration n-type semiconductor substrate (20), being left as it is such that both a p-type well and an n-type well are not formed in the semiconductor substrate, in contrast with a CMOS integrated circuit in which the p-type and n-type wells are provided in the low

concentration n-type semiconductor substrate (20).

10. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein a plurality of unit structures, each of which comprising the photo-gate electrodes, the photodetector layer, and the first floating diffusion layers, are arranged one-dimensionally or two-dimensionally so as to generate an image representing a range distribution.

11. The time-of flight range-finding sensor according to Claim 1 or Claim 2, further comprising a light beam scanner configured to generate incident beams into the range-finding sensor from a two-dimensional plane so as to generate an image representing a range distribution.

12. The time-of flight range-finding sensor according to Claim 1 or Claim 2, wherein range information is obtained from the ratio of two signals taken out respectively from the photo-gate electrodes (1 and 2), while intensity information is obtained from the sum of the two signals.